North Carolina Department of Transportation
Transportation Mobility & Safety Division
Spot Mobility Program Guidelines

The Spot Mobility Program systematically and objectively allocates Spot Mobility Funds to projects that provide the most benefit to reduce congestion across the state.

The primary audience for this document is the NCDOT Transportation Mobility and Safety Division (TMSD) and the NCDOT Transportation Divisions. These guidelines document the processes used by Regional Traffic Engineers (RTE), Division Traffic Engineers (DTE), the Spot Mobility Selection Committee, the Spot Mobility Team, and the Safety Evaluation Group to identify, analyze, prioritize and select projects for the Spot Mobility Program and to evaluate the effectiveness of these projects once complete.

All project related data should be entered into the Safety Database by the RTE. Document all estimates, projections, calculations, methodology and assumptions for projects and submit these with the project package.

Submitters are encouraged to consider innovative solutions to mobility problems. The Spot Mobility Business Plan contains more general information on the Spot Mobility Program.

Step 1: Identify Location and Mobility Problem
Potential projects may be identified by means such as: field observations, citizens' complaints, bottleneck rankings, analytical methods, etc.

Write a clear statement of the mobility problem that needs to be solved, such as "reduce average daily queue length on westbound approach to Sweeten Creek Road at Mills Gap Road in Buncombe County". Also state what the likely cause of the mobility problem is, such as the right turning traffic queues up at signal up to a specific distance. This is an important step and will be necessary to develop a project to fix the mobility problem as well as to calculate the benefits of the improvement from the constructed project.

Once a location having a mobility problem has been identified, compile background data including, but not limited to, the following:

- What is the origin of the request (i.e. citizen, elected official, internal)?
- What is the nature of the request (congestion, peak hour operations, etc.)?
- Collect or acquire pertinent data for the site, including:
    - Existing conditions, including:
        - Aerial photography
        - Utility information (overhead and underground)
        - Detailed field investigations
        - Existing traffic control devices
        - Physical Constraints

- Traffic count data (AADT, turning movement counts, growth rates, etc. related to problem statement)
- Other traffic data (speed data)
- Signal plans (if applicable)
- Safety data
- Previously applied treatments
- Potential impacts from proposed developments: inquire with District and Division Traffic offices.
- Future projects (TIP, Division, Municipal, etc.); Determine if these will address the problem
- Other data as required

Review the data and field investigations to identify the underlying cause(s) of the mobility problem. This may differ from what has been identified as the problem by the person or group submitting the request.

Step 2: Analyze No-Build Conditions

The Congestion Management Section (CMS) will analyze the no-build conditions to validate the problem and provide a basis for comparison. CMS will determine the appropriate analysis tool, ensuring that consistency between projects is maintained.

Step 3: Develop Alternatives

In conjunction with the RTE staff and Division staff, the CMS will develop alternatives to be analyzed. As part of this process, any design concepts and discarded concepts should be forwarded to the CMS for evaluation to identify non-practical alternatives and to prevent duplication. The CMS would appreciate any comments on the concepts that have been vetted and discarded. (ie. If a roundabout will not geometrically fit as a solution, note this so CMS knows it was considered.) In many cases, concepts will be identified when the project is submitted, however CMS will review the location to identify other potential alternatives and discuss these alternatives with the RTE to determine feasibility and practicality of alternatives.

Identify a Project Influence Area (analysis network) to ensure that the analysis of alternatives includes all impacts from the proposed concept. The analysis network should cover the same physical area as the no-build conditions.

Step 4: Analyze Alternatives

The CMS will perform traffic analysis for identified alternatives. The analysis methodology should match the no-build analysis process.

Measures of Effectiveness (MOE) will be identified in order to provide benefit values for comparison. The most common MOE will be travel time savings; however other MOEs may be used, such as number of stops, queue lengths, travel distance, average speed, and fuel and emission savings.
Initially this will be done from scratch for each project. Over time NCDOT will create travel time savings factors for different improvement types.

At this step a cost estimate for each feasible alternative should be developed. The RTE should request this data from the appropriate source.

Part of the analysis process should include identifying when the proposed improvement reaches the end of its effectiveness. This "Service Life" will be used for determining project benefits and annualized costs. The Service Life of a project will be the lesser of the effective life and the life span of the physical improvements proposed.

A proposed project may not provide a long-term resolution to the identified problem. Interim improvements may be considered as part of this process. Care must be taken to identify the appropriate service life of the improvement, in particular if a more elaborate, long-term solution has been proposed and/or scheduled.

Step 5: Select Recommended Alternative

Calculate a Mobility Benefit/Cost Ratio for each alternative submitted for funding consideration.

Ideally a project would be developed from the alternative that best meets the project's purpose and need as demonstrated by having the best Mobility Benefit/Cost Ratio. However, other factors may make this alternative infeasible for a Spot Mobility project.

Include documentation of the project's scope, description, MOE's and service life for each alternative submitted for funding consideration.

Submit the project for inclusion in the Safety database for prioritization.

Step 6: Prioritize Projects (Spot Mobility Program Index)

A key component of the Spot Mobility Program is the program index decision support tool. This Tool is modeled after NCDOT's Spot Safety Program Index Tool that has been in use since 2005. The Spot Mobility Program Index is information based evidence driven quantified formula that includes a subjective but knowledge based local priority component.

Formula Overview: MI = .40(MBC) + .30(LP) + .20(TTR) + .10(PI)

40 % Mobility Benefit Cost (MBC) Factor

30 % Local (Division/Region) Priority (LP) Score

20 % Travel Time Reliability (TTR) Factor

10 % Programmatic Identification (PI) (Meets multiple needs)

Mobility Benefit Cost (MBC) = 40%

To calculate the Mobility Benefit Cost Ratio

- Use a uniform statewide value of time of $22.00 per hour for all delay calculations. This value will be re-evaluated when on-going NCDOT research on this topic in complete.

- Calculate delay by subtracting the sum of the expected after treatment delays from the determined baseline delays. Be specific and use the appropriate values that match the stated purpose and need of the project: peak hour, 24 hour, seasonal, etc.

- Include only Spot Mobility Program Costs (PE, Construction, Utilities, and Right of Way) to calculate the cost of the project. Do not include other leveraged funds (other than Spot Mobility funds) in the MBC calculation. In the future, we will allow safety funds to be leveraged here. [This is consistent with how companion funds are encouraged (and can leverage additional investments in safety) in the Spot Safety Program].

Projects with average vehicle delay savings of less than 1 minute per vehicle will not be eligible for funding under the Spot Mobility demonstration effort. Average delay values can be calculated for a specific traffic movement (for example “Southbound Left Turn"). If the benefit is calculated for a specific movement, use the specific volume for that movement. Please provide sufficient data so that analysis may be done for both one specific movement and the overall intersection.

Document all estimates, projections, calculations, methodology and assumptions for projects and submit these with the project package. Once enough information and knowledge has been gained on the performance of mobility improvement treatment types NCDOT will then uniformly apply Standardized Statewide Mobility Improvement Factors for project development. Once available there will not be alternate approaches for deriving the Mobility Benefit Cost ratio for project development and comparison.

Initially the Mobility Benefit Cost Ratio scoring values will be categorized into four (4) equally distributed bins. These bins assign the number of points a project can score in the MBC term of the Spot Mobility Program Index. Point values will be assigned to each project by the Spot Mobility Program team once all projects have been evaluated.

Percentile	Points
100 – 76 %	40
51 – 75%	30
26 – 50%	20
0 – 25%	10

Once sufficient data is available re-calibration of the ranges may allow additional bins and associated ranges and points.

Local Priority (LP) - Division and Regional 30%

In each Division the Division Engineer (or delegate/designee) shall prioritize candidate Spot Mobility projects from 1 to N (N = number of candidate SM projects from that Division) with 1 (one) being the highest priority candidate project. Priority numbers cannot be duplicated (you cannot have two "Number One" priorities). The highest priority project will receive 15 points, with each successive priority receiving one less point.

Priority	Points
1	15
2	14
3	13
4	12
5	11
6	10
7	9
8	8
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15	1
16 +	0

The RTE will follow the same procedure as the Division Engineer (outlined above). Division and Regional Priorities do not have to align or have the same values.

All candidate Spot Mobility Projects (On Hold plus any new submissions) will be re-prioritized each quarter by the Spot Mobility Selection Committee.

Travel Time Reliability Factor (TTR) 20%

TTR is based on the change in the demand to capacity (v/c) ratio from the existing conditions to the proposed conditions. The v/c for the existing and proposed conditions can be calculated from traffic simulation, a macroscopic model like the Highway Capacity Manual/Software, or even a simple critical lane volume method. It is important that the calculation of the v/c be made with the same method for the existing and proposed conditions, keeping as many input values constant as possible. Once the existing and proposed v/c values have been computed, the TTR is determined in four steps as follows.

Step 1) If the proposed project will have a significant effect on reliability due to its handling of incidents, weather, work zones, and/or special events, conduct a special analysis of the proposal and assign a TTR in conjunction with management. Otherwise advance to Step 2.

Step 2) If existing v/c < 0.7, TTR = 0. Move to Step 3 if existing v/c > 0.7.

Step 3) If proposed v/c > 0.7,
Interim Score = (((existing v/c-0.7)*10)^2) - (((proposed v/c-0.7)*10)^2),
then move to Step 4.

If proposed v/c $\leq$ 0.7,
Interim Score = (((existing v/c-0.7)*10)^2), then move to Step 4.

Step 4) For existing v/c > 0.7, TTR = MIN (20, Interim Score).

The steps are easy to code in Excel. Step 1 is to allow for the rare and special proposed projects that affect reliability other than through day-to-day traffic variations. Step 2 is to insure that all proposed projects with existing v/c values below 0.7 result in a score of 0 as those sites are uncongested and are providing reliable travel times. The formula for existing v/c values over 0.7 (in Step 3) works by first subtracting the minimum level at which reliability begins to matter, 0.7, from the v/c values. Then we multiply the remainder by 10 to get the score into a 0 to 20 range. Next we square the revised scores to mimic the effect of the delay function and thereby reward projects that impact projects with higher v/c values and greater variability. After that, for projects with proposed v/c values over 0.7, we subtract the score for the proposed project from the score for the existing project so that the final score is based on the change in capacity and reliability. Finally, in Step 4 we set a cap of 20 points on the TTR to fit in the overall formula and insure that this dimension does not get too much weight in the overall selection process.

As an example of the calculation, suppose that we were evaluating a proposed project with no apparent effects on incidents, weather, work zones, or special events. The proposal would move the v/c at the site from 1.2 to 0.8. In step 2, the existing v/c at 1.2 is above 0.7, so we move on to step 3. In step 3, we perform the computation as:

Interim Score = (((1.2 - 0.7)*10)^2) - (((0.8 - 0.7)*10)^2)
Interim Score = ((0.5*10)^2) - ((0.1*10)^2)
Interim Score = (5^2) - (1^2) = 25 – 1 = 24

In step 4, we note that the interim score is greater than 20 so we assign TTR to be 20.

Programmatic Identification (PI) 10%

Programmatic boost to the Spot Mobility Index Score will be given if a candidate project location (intersection, road approach, road segment, corridor, etc.) has been identified by one or more established NCDOT Programs. The added value will be determined based on the following scale:

Identified By # of Programs or Lists	Points

4	10
2-3	5
1	2
0	0

Programs and Lists that can be considered for this PI value: (initial list)

- Highway Safety Improvement Program Listing
- Spot Safety Candidate Project List (On-Hold Projects)
- Most Congested Locations Listings by Division (Development by Division and TM&SD) ******
- Top 20 Bottleneck, from VPP Bottleneck Ranking
- STI Candidate TIP Project Spreadsheet
- Division Listing Based on Complaints (Maintained by Division and Submitted Updated Quarterly/Project turn in Cycle) ******
- NC Transportation Network Corridors (includes intersecting routes also (NCTN))
- City or MPO Project Listing ******

****** The State Traffic Engineer (STE) should receive routine updates of any prioritized list that wants to be considered for the Programmatic boost scoring. Additional Programs and Lists require advance approval of the STE.

Step 7: Approve Funding

Spot Mobility projects will be prioritized and selected by Spot Mobility Selection Committee and funded by the Board of Transportation.

Step 8: Design, Let and Construct Project

The Divisions will be responsible for developing, managing, and delivering these projects. The goal, as with Spot Safety, will be to deliver these projects within 18 months of funding approval.

Step 9: Evaluate Projects:

A mobility evaluation work plan shall be established in advance of a project being submitted for consideration. This plan should consider the mobility countermeasure implementation, measures of effectiveness, data collection needs, and a timeline of planned work. Any issues affecting project evaluation should be identified and documented. The recommended dates for performing the evaluation are important feedback. (ie. Improvements for a project addressing beach traffic would not be evaluated in January but should wait until June.) The mobility evaluation plan will ensure a potential countermeasure's effectiveness can and will be measured from the before period to the after period time frames.

Potential Types of Projects

- New Location
  - Community connector routes
  - Bypass routes
- Section Location
  - Corridor improvements
  - Sites that may include 2 or more intersections
- Spot Location
  - Intersection; Ramp; Driveway

Potential Data Needs for Projects

- Unsignalized Location
  - Geometry
  - Turning movement counts
- Signalized Location
  - Geometry
  - Before and after turning movement counts
  - Signal timing / phasing
- Traffic Volumes
- Travel Times
  - Field measure or simulate or pull from INRIX?

Potential Measures of Effectiveness (MOE) for Projects

- Travel Time Improvement? Delay Reduction?
- Volume Change
- Control Delay?
- Intersection Delay?

Thoughts and Questions for Evaluation Work Plan

- Need an evaluation work plan up front for each project
- How will the data collection be paid for?
- Need to investigate various sources of data / data collection
  - INRIX, system loops, traffic control, traffic volumes used in plan review
  - Consultant use for travel time studies
- When to perform analyses?
  - Just before project is let?

    - Just after Project is complete? 1 month after? 6 months after? Suggest 3 to 6 months
- Cheaper to do travel time studies as opposed to collecting volumes and modeling? More meaningful results also?
- Peak Hour analysis? All day?
- Consider doing actual before and after delay study / travel time study
- Who is the audience? Internal? External?
- What is the final product? Brochure? Technical Report?